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ABSTRACT

A study was undertaken to compare the effectiveness of two methods for delivering refresher training to Air Crews: conventional classroom and self-study. The self-study technique consisted of: (1) a comprehensive series of multiple choice questions covering the subject matter, with each question bearing reference to the page and paragraph of a manual containing the detailed information on which the questions were based; (2) a punchboard from which students could immediately determine whether their answers were correct or incorrect; and (3) a manual to which students could refer for information when they chose an incorrect answer. Conclusions were: (1) the preparation and administration of self-study techniques are entirely within the capability of an operational squadron with only a minimum of guidance; (2) in the operational setting, the self-study technique is superior to the conventional classroom method for delivering refresher training; and (3) students favor the self-study method for refresher training. (Author/EMH)

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**ADJUNCT TO SELF-STUDY FOR AIRCREW REFRESHER
TRAINING UNDER OPERATIONAL CONDITIONS
IN THE AIR DEFENSE COMMAND**

DONALD E. MEYER, EdD

MARCH 1965

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
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Foreword

This research represents a portion of the technical development program of the Technical Training Branch, Training Research Division of the Behavioral Sciences Laboratory. The research was documented under Project 1710, "Training, Personnel and Psychological Stress Aspects of Bioastronautics," Task 171007, "Automated Training and Programed Instruction." Dr. Gordon A. Eckstrand, Chief of the Training Research Division, was Project Scientist. Dr. Ross L. Morgan, Chief of the Technical Training Branch, was Task Scientist. The work was performed in coordination with the Air Defense Command under ADC Test Project 64-29, "Feasibility Study of Programed Instruction Under ADC Operational Conditions."

Included among the many individuals who contributed to the accomplishment of this study were: Major Edward W. Kenney and Major Norris A. Johnson, ADOTT-D, Headquarters Air Defense Command; Captain William J. Breckner and Captain Milton Johnson of the 87th FIS Training Flight at Lockbourne AFB, Ohio; Lieutenant Colonel Carey Land, Commander and participating Air Crews and operations personnel of the 87th FIS, Lockbourne AFB, Ohio; Colonel B. H. Emmert, 52nd Fighter Wing Operations and the participating members of the 2nd and 98th FIS, Suffolk County AFB, New York; and participating personnel from the 445 FIS, Wurtsmith AFB, Michigan. This research was started in March 1964 and completed in October 1964.

This technical report has been reviewed and is approved.

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Abstract

This is a report of the development and experimental comparison of a self-study technique with conventional classroom methods as a means of refresher training of Air Crews under operational conditions. The self-study technique consisted of (1) a comprehensive series of multiple-choice questions covering the subject matter with each question bearing reference to the page and paragraph of a manual containing the detailed information on which the question was based, (2) a punchboard by which students immediately determined whether their answer to each question was correct or incorrect, and (3) the manual to which students referred for information when they chose an incorrect answer to a question. The conclusions are: (1) the preparation and administration of the self-study technique is entirely within the capability of an operational squadron with only a minimum of guidance; (2) in the operational setting, the self-study technique is superior to conventional classroom methods in its effectiveness as a means of refresher training; and (3) students favor the self-study method for refresher training.

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SECTION I

Introduction

BACKGROUND

The task of an aircrew member in the modern defense structure is a highly complex one. Training toward mastery of the required skills and related knowledge is a long, arduous, and costly process. A portion of the learned repertoire falls into a unique category. It may consist of bits of information and behaviors that are infrequently used, or it may be in the nature of isolated factual information that does not lend itself to structuring for simple recall. Certain engineering features, some flying regulations, and alternative procedures for weapons deployment due to malfunction, etc., are in this category. Some of this seldom needed part of the repertoire is of a critical nature, ie, in certain situations, their proficient employment could mean the difference between disaster and safety, or between an abort and a successful mission.

An aircrew member practices many of his skills almost daily in normal mission performance. In these practiced areas, skill level and concept retention remain high. In those areas where a task is performed intermittently and at various frequencies by the different aircrews or aircrew members, a decrement in proficiency is an inevitable result. It is, therefore, necessary to conduct refresher training at prescribed intervals and on a continuing basis to maintain total proficiency at a desired level.

CONVENTIONAL METHODS

Typically, conventional classroom methods are used in presenting refresher training. Lectures by training officers and factory technical representatives, and occasional guest appearances by recognized experts in a given field are the approaches most frequently used. By modern educational technology standards, however, each of these approaches has deficiencies. Instructor limitations, the lack of any great amount of student participation, the lack of responsiveness to the individual needs of each student, a training schedule dictated by operational mission requirements, and difficulties in obtaining training aids and graphics are some generally recognized factors limiting the effectiveness of refresher training in operational units.

The nuclear age with its constant threat of vast destruction has established a requirement for the dispersal of operational units to insure a continuing defense and retaliatory capacity should an attack materialize. This trend toward widespread dispersal increases the magnitude and difficulty of conducting refresher training by conventional means.

PROGRAMED INSTRUCTION

Programed instructional techniques have been suggested as one way to provide refresher training in operational squadrons. An analysis of the more familiar techniques, however, reveals serious deficiencies for this application and can be discarded in view of (1) the skill level of the student, and (2) the lack of trained programmers. The purpose of refresher training is review of the subject material to clarify and emphasize both the critical and not so critical information to assure acceptable skill and knowledge levels. The aircrew members who comprise the student population are already familiar with the subject-matter areas. However, a typical cross section of aircrews reveals considerable variance in background and experience levels, as well as recency of formal training, personal habits and capabilities. Proficiency is scattered across a considerable range. The use of one or more of the familiar programming approaches appears inappropriate in that when detailed enough for the lower proficiency levels, it is much too basic for the more proficient students unless extensive branching is used. Also, the more familiar programming techniques require trained programmers and considerable time to prepare.

SECTION II

Self-Testing-Teaching

After considerable consultation with experienced operational aircrew members, a self-testing-teaching technique was selected for experimental trial. The technique consisted of the development of a comprehensive and carefully sequenced series of multiple-choice questions designed to cover all of the important details of the technical order manual (T.O. IF-101B-29, Weapons Manual). The exact page and paragraph number in the technical order manual from which the question was derived is contained with each question. The self-study procedure then consists of self-testing using a punchboard as a confirming device. If the correct answer is known by the student, it is confirmed as correct by the punchboard, and the student then goes on to the next question, etc. If the correct answer is not known, or a response is confirmed as incorrect by the punchboard, the student uses the provided reference to the T.O. page and paragraph number to locate the information needed to respond correctly. Figure 1 diagrams the adjunct method.

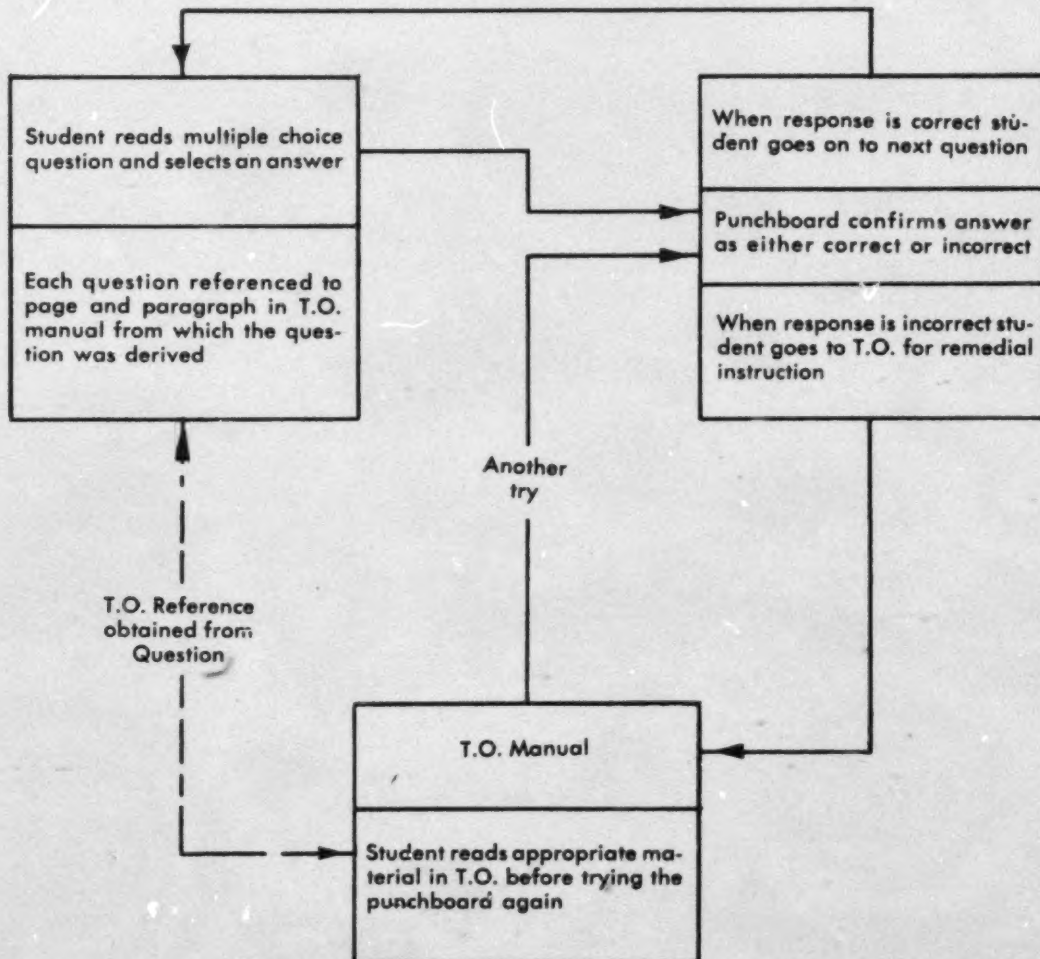


Figure 1. Diagram of Adjunct Method

A number of advantages inherent in this technique are particularly suitable for the existing training situation:

- (1) The self-instructional sequences, ie, the multiple-choice questions can be quickly made up at squadron level by operational personnel without extensive training or practice in programing techniques,
- (2) Existing documents can be used as the instructional material,
- (3) The punchboards and scoring keys can be inexpensively manufactured by squadron personnel, using readily available base facilities,
- (4) It offers the student a means to progress through the instructional sequence at his own pace and in the minimum time consistent with his individual level of knowledge,
- (5) Students can be "instructed" only in areas of deficiency, thus saving both time and frustration,
- (6) The program, punchboard, and T.O. can be conveniently carried to a place and used at a time of the student's choosing, and
- (7) The punchboard response confirming device appears to have a motivational effect upon subjects who use it.

PURPOSE OF EXPERIMENTS

Experimental studies were conducted to evaluate the potential value of the technique for operational use. More specifically the experiments were conducted:

- (1) To determine if the punchboard technique of preparing self-instructional materials is within the capability of an operational squadron,
- (2) To compare the effectiveness of the self-study technique with conventional classroom instruction, and
- (3) To obtain an estimate of student reaction toward the use of self-study method employed.

METHOD OF MATERIALS DEVELOPMENT

To assure comprehensive coverage of the subject matter to be presented, the first step was to carefully go through the Technical Order Manual (T.O. 1F-101B-29, Weapons Manual) to estimate, by paragraph, the number of questions needed to thoroughly cover the subject matter content. Two squadrons¹ were then furnished the resulting breakdown by page, paragraph and number of questions required, together with a request that each of their qualified officers be assigned the responsibility for making up 10 multiple-choice, 4 alternative-response questions covering the specified paragraphs, and marking the correct answer as well as listing the page and paragraph number to which each question had reference. (See Appendix I.) Guidelines for the preparation of questions were drawn up and furnished each officer. (See Appendix II.) An extensive item pool of questions, suitably referenced, was thus obtained. From this pool, questions were selected, edited, and sequenced to form the self-study program which consisted of 229 items. (See Appendix III for sample pages.)

From the item pool, 50 questions were drawn to make up the criterion examination. Care was taken to assure that a representative sampling of the subject matter was covered and to avoid duplication of any item used in the instructional program. The same items used for the pretraining test were presented in reverse order as the posttraining test.

The punchboards used as response confirming devices were designed and fabricated by an operational Air Defense Command (ADC) Squadron². The punchboards were designed to use metal slide-in scoring keys to accommodate any number of instructional test items by a change of answer keys. Figures 2 through 7 detail punchboard construction and use.

¹ 2nd and 98th Squadrons, 52nd Fighter Wing, Suffolk County AFB, N.Y.

² 87th Fighter Interceptor Squadron, Lockbourne AFB, Ohio.

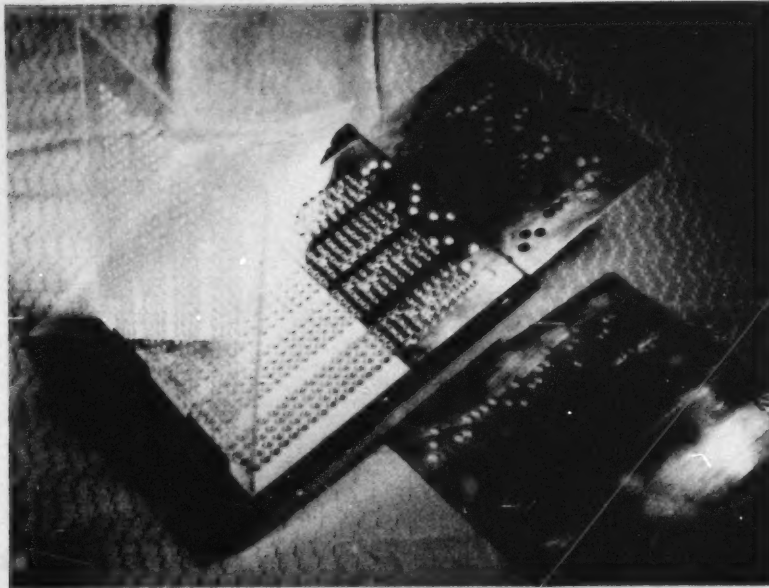


Figure 2. Construction Details. The hinged top of the punchboard is open to receive the answer sheet. The metal scoring key is partially inserted.

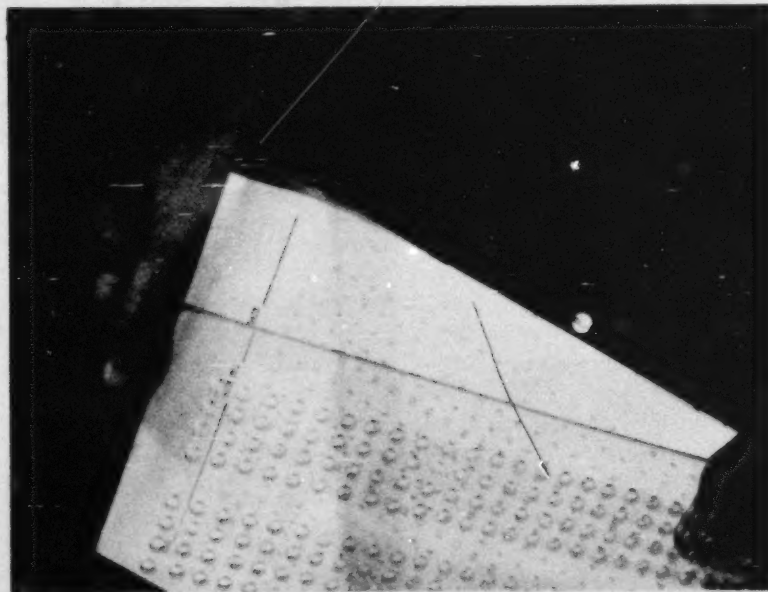


Figure 3. Aligning the Answer Sheet

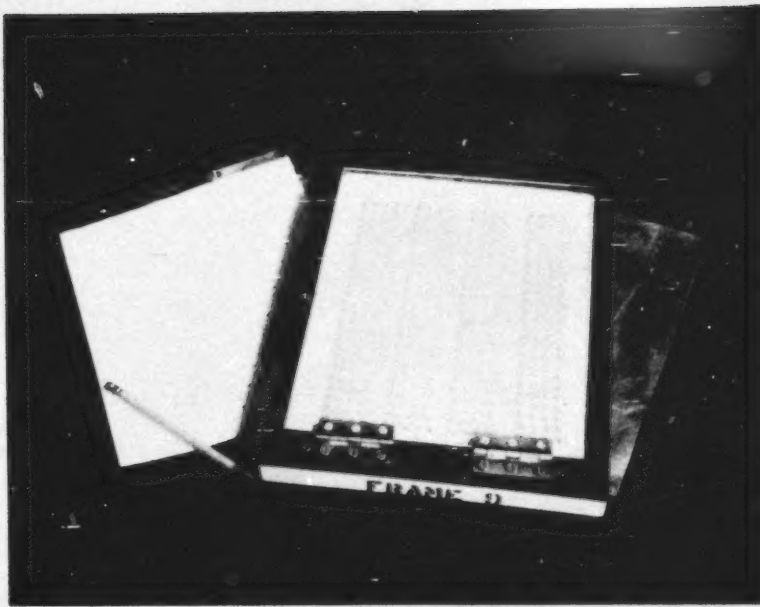


Figure 4. Ready for Use

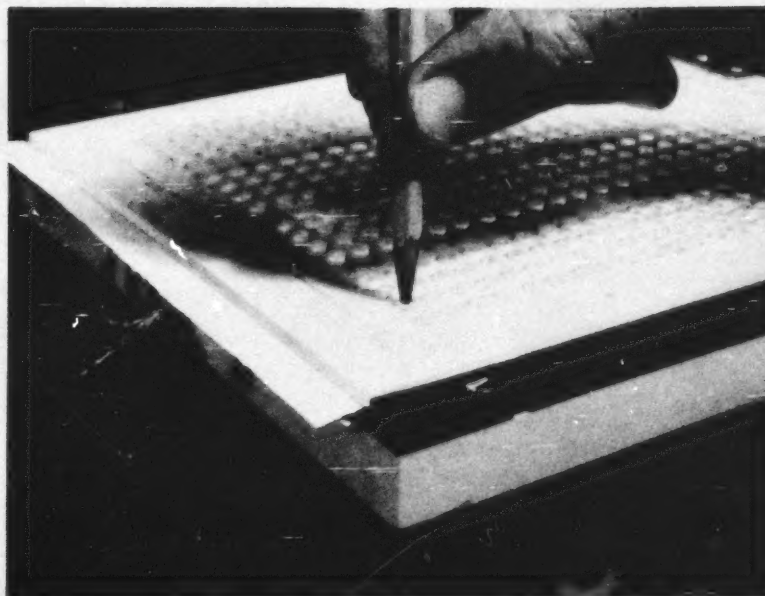


Figure 5. Incorrect Response. (The pencil perforates the paper but goes no deeper.)

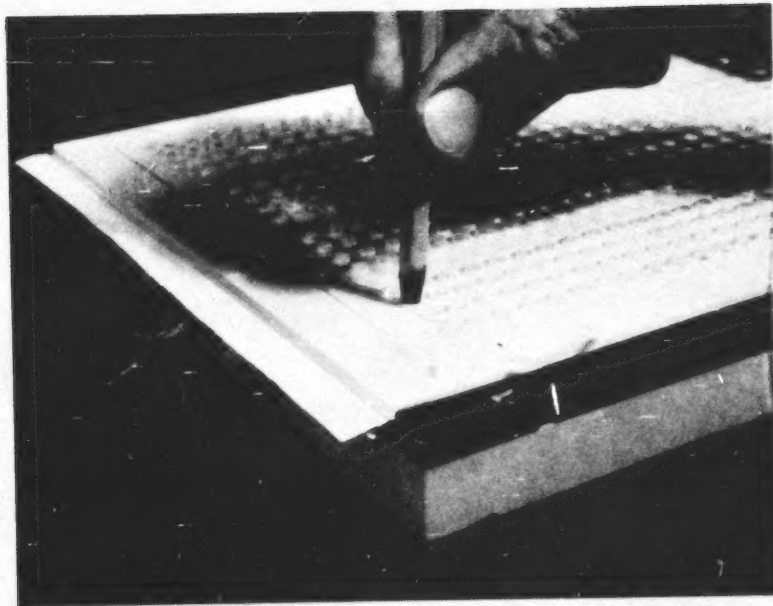


Figure 6. Correct Response. (When punching a correct response the pencil penetrates deeply. There is no doubt as to which response is correct after punching one right and one wrong response.)



Figure 7. Employing the Adjunct Method

EXPERIMENT I

Procedures and Findings

The experiment was initiated with the administration of a 50-item multiple-choice pretraining test to the 2 participating squadrons. (Henceforth, the squadron given instruction by the self-study method will be referred to as the Experimental Group, and the squadron receiving conventional classroom instruction will be referred to as the Control Group.) The pretraining test was undertaken to estimate the comparability of the two groups on the basis of knowledge. The results are summarized in table I.

TABLE I
EXPERIMENT I PRETRAINING TEST

	<i>Experimental Group</i>	<i>Control Group</i>
Number of subjects	34	30
Mean raw score	34.41	32.73
Mean score in per cent	68.82	65.46
Standard deviation	4.76	5.84
Standard error of the mean	.82	1.07

A t-test of statistical significance was applied to these data. The obtained t-value (1.25) indicated no significant difference between the means of the two groups. Upon this basis, the two groups were judged to be at comparable levels of knowledge prior to the training prescribed.

Subjects in the Experimental Group were instructed to work through the self-study booklet at least once during the 11 days scheduled for the experiment. Personnel in the Control Group were to be scheduled for classroom instruction covering all of the subject material during this period. Members of both groups were instructed to keep accurate records of the amount of time individually spent in their respective modes of instruction. Although the resulting records are probably more in the category of time estimates than precise measures, they are included in this report to form a basis for comparison. Subjects in the Experimental Group averaged 4 hours and 13 minutes of self-study, compared to an average of 1 hour and 13 minutes of classroom instruction for subjects in the Control Group. Most of the subjects in the Experimental Group reported going through their self-study materials twice. A number of factors intervened which interrupted classroom schedules for the Control Group (temporary duty (TDY), extended alerts, assignments to ferry aircraft, etc.). This, however, is a normal condition in an operational squadron faced with mission responsibilities. The Experimental Group, though faced with the same responsibilities, was able to devote an average of almost four times more time to instruction than the Control Group, due to the self-study feature; ie, subjects could study at a place and time of their own individual choice, independent of any group effort or fixed schedule.

A posttraining test was administered to both groups 11 days after the initiation of the project. (Posttest was a scramble version of the Pretest.) The results are summarized in table II.

TABLE II
EXPERIMENT I POSTTRAINING TEST

	<i>Experimental Group</i>	<i>Control Group</i>
Number of subjects	34	30
Mean score	41.44	35.97
Mean score in per cent	82.88	71.94
Standard deviation	4.55	6.27
Standard error of the mean	0.784	1.143

The 3.949 t-value obtained from these data indicates a difference between means that is significant beyond the .001 level in favor of the Experimental Group.³

Subjects in the Experimental Group were asked to complete a questionnaire immediately following the posttraining test, for an estimate of the degree of acceptance of the self-study technique. Most responses indicated a high degree of acceptance and enthusiasm for the self-instructional technique. (See Appendix IV for a recapitulation of responses, and a verbatim list of comments made by individual subjects.)

The findings of this experiment indicate:

(1) The preparation of the punchboards and self-instructional materials are well within the capabilities of an operational squadron,

(2) The self-study technique is superior to conventional classroom refresher training as measured by the posttraining examination, and

(3) The subjects who participated in the self-study program were generally enthusiastic in support of the self-study method.

The disproportionate study times (1 hr. 13 min., conventional; 4 hrs. 13 min., self-study) are realistic comparisons that emphasize the difficulty of conducting group instruction under operational conditions. The almost four times more study time available to subjects engaged in self-study was a decided advantage over the conventional instruction approach. From an operational viewpoint, the study time disparity marks the self-study method as definitely advantageous. Experimentally, however, a question arises concerning how well the self-study method would compare if the same amount of time were devoted to classroom instruction. On this basis, the experiment was repeated with the time factor held constant.

EXPERIMENT II

Procedures and Findings

Two operational squadrons were again identified as experimental participants. As in the first experiment, the squadron assigned the self-study technique will be referred to as the Experimental Group, with the conventionally taught squadron as the Control Group. Both groups participating in the experiment were pre-tested using the same 50-item multiple-choice test used in Experiment I to determine the comparability of knowledge levels prior to training. The results of the Experiment II pretraining test are summarized in table III.

TABLE III
EXPERIMENT II PRETRAINING TEST

	<i>Experimental Group</i>	<i>Control Group</i>
Number of subjects	26	24
Mean score	34.19	32.04
Mean score per cent	68.38	64.08
Standard deviation	4.89	4.62
Standard error of the mean	.96	.94

³ A statistical comparison of gain scores was also computed. It revealed a t-value of 4.09 which is significant at beyond the .001 level.

The two groups were judged comparable upon finding a nonsignificant t-value.

The Control Group was then given a 50-minute instructional period each day for 5 consecutive days. The lecture method was utilized for this instruction by a well qualified Fighter Interceptor Weapons Instructor. Subjects in the Experimental Group were directed to work through the self-study program twice during the experimental period and to individually maintain accurate records of the amount of time so spent. It had been determined in the previous experiment that approximately 250 minutes were required. The result was comparable training times for the two groups. Subjects in the Experimental Group spent an average of 253 minutes in self-study, compared to 250 minutes of classroom instruction for the Control Group.

The posttraining test was administered to both groups at the completion of the instruction periods. The results are shown in table IV.

TABLE IV
EXPERIMENT II POSTTRAINING TEST

	<i>Experimental Group</i>	<i>Control Group</i>
Number of subjects	26	24
Mean score	40.89	35.79
Mean score per cent	81.78	71.58
Standard deviation	3.79	5.24
Standard error of the mean	.74	1.07

The obtained t-value of 3.95 indicates a difference between means that is significant at the .001 level in favor of the Experimental Group.⁴ The gain in achievement over the pre-test was 13.40 percentage points for the Experimental Group, compared to a 7.50 percentage point gain for the Control Group.

As in the first experiment, a student reaction questionnaire was administered to subjects in the Experimental Group. The results again were generally favorable toward the self-study technique. (Appendix V recapitulates the questionnaire results and lists of comments written by subjects in this group relative to their estimates of the advantages and disadvantages of the technique.)

An examination of the frequency distributions of the scores obtained by the two groups reveals interesting differences (see table V). Of the subjects in the Experimental Group, 27 per cent scored as high or higher than the highest score made in the Control Group. Only 17 per cent of the Control Group scored at or above the mean of the Experimental Group, while 88 per cent of the Experimental Group scored above the mean of the Control Group. Of the subjects in the Control Group, 21 per cent scored lower than the lowest score made in the Experimental Group. The scores ranged from 32 to 49 for the Experimental Group compared to a range of 23 to 44 for the Control Group.

⁴ A statistical analysis of gain scores revealed a t-value of 2.60 which is significant at the .02 level for a two-tailed test or beyond the .001 level for a one-tailed test.

TABLE V
EXPERIMENT II POSTTRAINING TEST FREQUENCY DISTRIBUTION

Score	Experimental Group	Control Group
50		
49	1	
48	0	
47	0	
46	0	
45	2	
44	4	1
43	2	0
42	3	1
41	5	2
40	1	2
39	2	1
38	1	2
37	2	6
36	0	0
35	1	1
34	1	2
33	0	1
32	1	0
31		1
30		2
29		0
28		0
27		0
26		0
25		0
24		1
23		1
22		

27%

88%

17%

Mean Cont. Gp.

21%

Mean Exp. Gp.

SECTION III

Discussion

The statement that "no single training technique or method is universally adapted to all training situations" would probably be argued by no one. There are, however, classes or categories of training situations to which certain approaches seem particularly appropriate. The self-study technique used during this study appears suitable to training needs in the categories of review and refresher training. The use of punchboards or other response-confirming devices is not unique in the technology of training. A history of such contrivances is found in the existing literature.⁵ The present study emphasizes the potential of this method of instruction in a "do it yourself" environment.

The modern defense structure with its isolated site and dispersal requirements is such that conventional group instruction after an individual is assigned to a command is, in many cases, not practical. Inappropriate facilities, the nature of the assigned mission, limited operating budgets, and the lack of trained instructor personnel conspire to rule out onsite group instruction as an effective approach to continuation or refresher training. Self-instruction, then, appears to be the best if not the only means of providing this necessary function.

Conventional manuals, texts, and technical orders are provided for most of the required fields of knowledge, but the mere reading, even of the best of these when considered as the only means of instruction, is of limited effectiveness. The new and rapidly developing field of programmed instruction has proved to be an effective means of solving the problems of self-instruction. The task of programming, however, is a costly and time-consuming process, requiring considerable training for mastery. Moreover, this degree of pedagogical thoroughness and refinement may not be necessary in some areas. Most refresher training of the kind required by the operational commands appears to be of this type. Here the student has already been trained or is experienced in the required tasks. For maximum effectiveness, the student's instruction should center only in areas which have been forgotten or confused through lack of use. To spend time, money, and effort in instructing a person concerning material he already knows is pointless and is as frustrating to the student engaged in self-study as it is to a student in a conventional classroom.

The adjunct technique used in this study seems to avoid many of these objections. By utilizing existing publications as information sources, the most expensive single cost is sidestepped. The questions and response-confirming devices can be quickly and easily made up without extensive training in programming techniques. It is suitable for students at heterogeneous levels of knowledge. And since students are instructed only in areas of deficiency as confirmed by their responses, it is economical in its requirements on student time and effort, because it provides direct reference to the page and paragraph numbers in the text to correct the deficiency. Also, it is easily portable and can be studied at a time and place of the students' own choosing, is self-paced, and can be mastered in short settings since the steps (questions) are discrete items rather than related items of continuous discourse. The use of the punchboard seems to have motivating aspects, apparently adding some features of game playing. Most students favored its use as a self-study method. Last, and perhaps most important, it is an effective training technique.

These features provide a powerful argument for careful consideration of this technique by operational commands faced with refresher training requirements. The cost and ease of implementation are minimal in view of the findings and conclusions of this study.

⁵ Lumsdaine, A. A. and Glaser, R. S. (Editors) *Teaching Machines and Programmed Learning*, Part II, pp 32-38, National Educational Association, Washington, DC, 1961.

SECTION IV

Conclusions

The findings of the two experiments conducted during this study indicate:

- (1) The preparation and administration of the self-study technique is entirely within the capability of an operational squadron with only a minimum amount of guidance.
- (2) In the operational setting, the self-study technique is superior to conventional classroom methods in its effectiveness as a means of presenting refresher training.
- (3) Students are favorable in their acceptance of the self-study presentation for refresher training.

Appendix I

PROCEDURAL DIRECTIONS FOR QUESTION PREPARATION

The following directions were furnished the operational squadrons charged with preparing the initial pool of questions from which the program and criterion examination were taken. (The Guidelines referred to in the third paragraph are contained in this report as Appendix II.)

A suggested approach for obtaining assigned questions (Weapons Manual):

1. The following lists a break down of the T.O. IF-101B-29 by page, paragraph and the number of questions needed for comprehensive coverage of its informational content.
2. To obtain the needed questions in a minimum amount of time, it is suggested that you use the list by assigning each of your qualified officers the responsibility for making up 10 multiple-choice questions covering specified paragraphs and for marking the correct answer as well as the page and paragraph number from the manual for verification of reference for each question.
3. When you make the assignment, it is requested that you furnish each officer with a copy of Guidelines for the Preparation of Questions on the Weapons Manual. Please ask for close adherence to the guidelines. Experience has proved that better questions generally result from attention to these details.

BREAKDOWN

	<i>Minimum number of Questions needed</i>
Safety Rules.....	15
Section I.....	111
Section II.....	39
Section III.....	28
Section IV.....	46
Total.....	239

SAMPLE BREAKDOWN OF QUESTIONS REQUIRED PER PARAGRAPH

SAFETY RULES

<i>Paragraph heading</i>	<i>Number of Questions</i>
General.....	1
Security.....	2
Two-man concept.....	2
Equipment and procedures.....	1
Grnd Ops. Involving Wpn loaded A/C.....	4
Peace-time flying.....	4
Practice Alerts, Exercises: Inspection and Evaluation.....	1
Total.....	15

Appendix II

GUIDELINES FOR THE PREPARATION OF QUESTIONS

1. Each item must be a multiple-choice question.
2. Cite the page number and paragraph heading in the weapons T.O. that answers each question you submit.
3. Each item should be practical and realistic. Each item should represent some fact worth knowing. Avoid trick questions or trivial points.
4. The stem of each multiple-choice item should contain a central problem in the form of a direct question. Don't answer one item in the stem of another.
5. The problem statement should be specific, clear, and as brief as possible.
6. Each item should contain four alternative choices. One choice should be *absolutely* correct; the others should be wrong, but not so obviously wrong that they could be rejected by a person who knows little about the subject. It is best if the wrong alternatives represent common misconceptions or errors.
7. When choices include a series of figures, the figures should be listed in ascending order (ie, 5, 10, 15, 20).
8. Avoid negative-type questions when possible. If a negative-type question is definitely more desirable, be sure to make it clear that a negative response is sought.
9. Administer the final copy of each proposed item to at least one qualified officer who has not participated in its development.

Appendix III

PROGRAM SAMPLE

Page 1-5
Paragraph 1-7

24. With JETTison selected and the trigger depressed fully, if #1 AIR-2A is not aboard, #2 will JETTISON:

- a. Immediately after door rotation.
- b. 2.5 seconds after door rotation.
- c. 5 seconds after door rotation.
- d. Will not JETTison until circuit is cleared through TRIG SALVO.

Page 1-5
Paragraph 1-8

25. When firing the missiles manually, after the 13-second preparation time has elapsed the missile will fire approximately.....seconds after trigger two has been depressed.

- a. 1.
- b. 2.
- c. 3.
- d. 4.

26. When the AIM-4C is fired via the TRIG SALVO position, the missiles.....:

- a. Are timed to self-destruct.
- b. Will guide after motor burn-out.
- c. Are jettisoned in an unarmed state.
- d. May glide for up to 27 seconds.

27. The ARM position unlocks the *armament preparation* and *firing circuits* in:

- a. JETT, RAD, IR.
- b. JETT, TRIG SALVO, VIS-IDENT.
- c. MAN, FCS, IR.
- d. MAN, JETT, TRIG SALVO.

28. The MASTER ARM SWITCH Circuit is bypassed in which of the following modes?

- a. JETT, RAD, VIS-IDENT.
- b. JETT, TRIG SALVO, MAN.
- c. JETT, MAN, TRIG SALVO.
- d. JETT, VIS-IDENT, TRIG SALVO.

29. With MISSILES loaded and selected what does an OK in the annunciator window indicate?

- a. That missile electrical connectors are properly installed and that electrical continuity exists.
- b. That the missiles are installed and the retro-launch switch on the missile racks are tripped in place.
- c. The missile gyro circuits are receiving power.
- d. That at least one rail is occupied by an AIM-4C or WSEM.

30. With SPL WPN loaded and selected, what does an OK in the annunciator window indicate?

- a. The weapon will be prepared and fired.
- b. The ejector rack is occupied.
- c. That electrical continuity is established with the weapon.
- d. That the ejector racks firing circuits have been activated and the weapon will fire.

31. After completing the proper arming sequence, the first indication that electrical continuity is established for the rocket is:

- a. An OK appears in the armament selector panel annunciator window.
- b. Attack mode light illuminates.
- c. Rocket armed light illuminates.
- d. VIS-IDENT light goes out.

Appendix IV

REACTION QUESTIONNAIRE — EXPERIMENT I

Subject Responses in Per Cent

1. Had this instruction been given in the usual manner instead of by self-study, I would have learned:
 - 67% a. Much less from the course.
 - 33% b. About the same from the course.
 - 0% c. Much more from the course.
2. In comparing this unit of self-study with an equal time and effort devoted to conventional instruction I feel:
 - 27% a. I learned much more from this self-study unit.
 - 52% b. I learned somewhat more from this self-study unit.
 - 15% c. There was little difference.
 - 6% d. I would have learned somewhat more by conventional instruction.
 - 0% e. I would have learned much more by conventional instruction.
3. The self-study program:
 - 88% a. Held my attention better than conventional instruction.
 - 9% b. Held my attention as well as conventional instruction.
 - 3% c. Did not hold my attention as well as conventional instruction.
4. The punchboard upon which I scored my answers:
 - 52% a. Added greatly in holding my interest.
 - 42% b. Does have some motivating aspects.
 - 0% c. Did little to enhance the course.
 - 6% d. Is an interesting gadget, nothing more.
 - 0% e. Seriously detracted from learning the material presented.
5. Did you miss not being able to participate in class discussions or asking questions as you would have in a conventional class?
 - 73% a. No, not in the least.
 - 27% b. Yes, somewhat.
 - 0% c. Yes, very much.
6. If "punchboard" self-study programs were available for other refresher training:
 - 88% a. I would prefer the self-study course over conventional instruction.
 - 9% b. It wouldn't make any difference to me which course I took.
 - 3% c. I would prefer conventional instruction over the self-study method.
7. Please comment in your own words about your reactions to the self-study course (advantages, disadvantages, strengths, weaknesses, etc.)^a

^a These are verbatim responses made to Item 7 of the questionnaire. Comments by individuals are separated by quotation marks.

"This is, without a doubt, the finest method of self-instruction I've ever been acquainted with. Change nothing and get some more "punchboards" for other material we are responsible for."

"Excellent."

"It is good because it can be done a few questions at a time as your normal duties permit. It is also more interesting."

"A. The biggest advantage of this particular form of self-study is elimination of effort expended to cover material already known.

"B. The elimination of the group haggle is also a definite advantage.

"C. This type of study is good if used. Thought should be given to some sort of control to insure that the lazy man and the habitual goof-off utilize it when offered."

"Ref. to #5 this program does not necessarily limit discussion. I have learned more from this course than before by other means."

"I feel that the self-study course is a valuable training aid. It permits an opportunity for self-study in areas where class study is often misdirected for an individual's needs. There are, however, some shortcomings such as keeping the questions up-to-date and learning test questions and answers instead of understanding of tested material."

"I enjoyed this novel method of studying as did other members of my flight, and not only because of the novelty but because the system allows one to move at his own pace, organizes material from a poorly written manual, and forces the student to look up only that material which he has forgotten or didn't know. This makes for much more efficient study time and naturally it follows that the student will not be bored, reading over material he is already familiar with."

"The 29-1 is very poorly organized and this method of study helps guide me through the armament information. I thought the method to be well thought out and very convenient to use. Manuals etc. with more material in them should be broken up into specific subject areas for as complete coverage."

"I feel that the self-study program will be beneficial because it eliminates hours of searching through the manual for new material. We are made aware of the areas in which we are deficient, and we concentrate on these areas instead of rationalizing that we "know it all" when we re-read the same familiar material."

"Because of excessive crew duty hours, and the problem of assembling all crews for class type presentation, the self-study type instruction is ideally suited for ADC type operation."

"Advantages — Allows faster coverage and learning of material. Retains interest — enough to repeat test frequently. Easier to cover material. I feel that something such as this is necessary for the amount of material aircrews must know. Also it has to be reviewed occasionally to be retained. It is difficult to do so and retain interest by the conventional method."

"Adv. Max. time spent on unknown material. Min. time spent on material I was familiar with. It is a systematic form of study assuring coverage of material."

"I like it."

"This is a good approach to use as a review. Even though I answered some questions with the correct answer I still read the paragraphs, referenced, to clear up some other questions that arose as a result of the program question."

"One advantage is that you are allowed to study at your own convenience (no ground school on days off). The biggest advantage is that you can cover only the things you don't know."

"Advantage can be used at short intervals of time. Does not require large block for instruction. Ideal for our working conditions."

"The main factors in the self-study course were —

- "1. An aid to study at your own convenience.
- "2. Pointing out items missed during study of the material.
- "3. An aid in holding attention over a long study period."

"Excellent — Allows study at each individual's convenience and rate of progress is controlled by the student. Normal sqdn ground school is usually rushed. I hope this program is adopted."

"A better designed punchboard is going to be necessary to take the rough, abusive every day handling given them by people."

"A definite disadvantage is that more facts were introduced and less frequently, which made more to remember and less chance to pick out the most important facts. There didn't seem to be any concentration on any certain area which was good, but it would have helped to cross-fire the questions more to achieve a better programed learning factor. The general idea is excellent and I feel it would be most profitable for the individual as well as the Air Force to adopt such a program in almost all phases of operation."

"The main weakness is if a correct answer is guessed and is not looked up the person still doesn't know the material."

"This particular course was too long. Why the odd number of questions — 229?"

"If the answer to each question is looked up prior to answering — I can find no great advantage other than seeing a "TYPE" question. However, if the question is read and an answer seems ideal and is punched — then there is benefit. The game of outguessing the quizzier only hurts yourself in this type program. For myself — I thought it a very easy and painless way of covering a dull/fact filled book."

"Very good with these exceptions:

- "1. Course taken was too long (229 questions). Several lengthy courses such as this would get old in a hurry.
- "2. Several questions were repetitive of others, sometimes the immediately preceding ones."

"I believe that with a very good knowledge of the material before taking programed instruction it would be a very good program. The questions were very thorough and exacting. I understand these are the conditions under which the program is designed and if used in this manner it will be very effective. Personally I believe in studying the material first and then taking the programed tests to discover weak areas. When I say I would prefer conventional study, I mean self-study and not classroom instruction."

- "1. Self-study course questions should not be taken out of context *as often*, thereby forcing the student to get a more comprehensive outlook.
- "2. 100 ques. (very few taken verbatim out of book) would be adequate. If subject is of vast nature — break it down, *do not* make a thousand question self-study course!
- "3. Enjoyed punchboard routine very much. Am very glad to see improvement in test areas in the Air Force — *always*."

"One of the weaknesses of the self-study program is that the answers are taken verbatim from the —29. Therefore, rather than look at the paragraph, a person would tend to start punching

other holes in the question series rather than look it up. If the correct answer was a resume of a paragraph I feel the individual would go to the manual and read the paragraph and thereby gain a bit more from it."

"A qualification on question #6. Both types of study are needed. This provides a more detailed method of getting facts and remembering them. I believe there would be serious problems in teaching new *concepts* with this method. A punchboard on a larger mass of material would have to be broken down. 200 odd questions are too much for one sitting."

"At first thought to be Bally Ho — done proper a good program, although I don't think the best. Specific recall of fact does not always indicate knowledge of."

"Method of instruction was very good. The only shortcoming was that for a program of this length (220 questions) a longer time period should be given to complete it, or it should be broken down into smaller sections. I personally would have learned much more from the course if I wouldn't have had to complete it at one sitting."

"Too many questions and answers involved. This tended to confuse me after I went through the program the second time. I feel I would have done better on this exam if it had been given a little *later* in the day."

"I don't feel that a proper evaluation of the system has been conducted by this first experiment. At least one more attempt, with less persuasion and pushing should be attempted."

Appendix V

REACTION QUESTIONNAIRE — EXPERIMENT II

Subject Responses in Per Cent

1. Had this instruction been given in the usual manner instead of by self-study, I would have learned:
 - 61% a. Much less from the course.
 - 36% b. About the same from the course.
 - 3% c. Much more from the course.
2. In comparing this unit of self-study with an equal time and effort devoted to conventional instruction I feel:
 - 42% a. I learned much more from this self-study unit.
 - 45% b. I learned somewhat more from this self-study unit.
 - 10% c. There was little difference.
 - 3% d. I would have learned somewhat more by conventional instruction.
 - 0% e. I would have learned much more by conventional instruction.
3. The self-study program:
 - 78% a. Held my attention better than conventional instruction.
 - 19% b. Held my attention as well as conventional instruction.
 - 3% c. Did not hold my attention as well as conventional instruction.
4. The punchboard upon which I scored my answers:
 - 26% a. Added greatly in holding my interest.
 - 55% b. Does have some motivating aspects.
 - 16% c. Did little to enhance the course.
 - 3% d. Is an interesting gadget, nothing more.
 - 0% e. Seriously detracted from learning the material presented.
5. Did you miss not being able to participate in class discussions or asking questions as you would have in a conventional class?
 - 71% a. No, not in the least.
 - 29% b. Yes, somewhat.
 - 0% c. Yes, very much.
6. If "punchboard" self-study programs were available for other refresher training:
 - 87% a. I would prefer the self-study course over conventional instruction.
 - 7% b. It wouldn't make any difference to me which course I took.
 - 6% c. I would prefer conventional instruction over the self-study method.
7. Please comment in your own words about your reactions to the self-study course (advantages, disadvantages, strengths, weaknesses, etc.)⁷

⁷ These are verbatim responses made to Item 7 of the questionnaire. Comments by individuals are separated by quotation marks.

"I feel that the self-study course allows for greater flexibility in that an individual can proceed at his own pace, and places more emphasis on needed areas rather than stuff already learned."

"Very good program, what with our fouled up schedule in ADC!"

"I think it's an excellent idea — should be used to augment conventional instruction."

"Advantageous if used properly. It is cumbersome for one individual to control the classified books, but should provide the individual with more learning for the same amount of time spent in lectures."

"I enjoyed it — something different!"

"Advantages: It is easily adopted to a tight work schedule. It does not have to be completed at one sitting and can be accomplished at your convenience."

"I think the self-study course should be supplemented by conventional instruction and discussion."

"Very good. Should be used for as many subjects as possible; however, it should not be rushed as this evaluation was. If adequate time had been given for the self-study I could have received far more learning from the program."

"Good for a continuation type training."

"I feel that the self-study method is better for the aircrew that does have some knowledge of the system already. Also it is very good in that you are not forced to study areas in which your knowledge is already high. I feel that it would be of benefit to me in all areas. The conventional methods force the aircrew to sit thru hours of ground school in many areas in which his knowledge is high. (Be more careful in drilling holes in answer templates, as you really had to feel around on some of them.)"

"The punchboard was not a necessary part of this programed learning. I feel that it added little to the program. However, the idea of programed self-study learning is well taken. It is productive and quite helpful. Allowing the individual to set his own pace is a real asset. I believe expansion of the program is in order and such comprehensive question books should be written for the full spectrum of aircrew requirements."

- "Advantages:
1. Holds interest better than conventional study.
 2. Self-study is superior to group study.
 3. Saves time.

"Disadvantages: 1. Person tends to memorize the specific questions and answers rather than get a deep understanding of the material."

"1. There is little if any motivation for self-study. Inherently busy individuals will not utilize the program.

"2. The self-study course is, however, very good if a minimum requirement is placed upon the individual and enough manuals are available for proper research of correct answers.

"3. Over a period of time (after six to eight weeks) very little use would be made of the punchboards and constant revision of material unless performed by an outside agency would result in disuse.

"4. Three out of four answers are wrong. Time is wasted reading these wrong answers. This time could be better spent learning the one right answer (movies covering specific subject, graphic illustration, well conducted, interesting lectures)."

"Enjoyed it. Advantages include convenience, privacy, learning at one's own pace. Questions can always be saved for qualified instructors if the program or T.O. do not give specific answers. Absences have no bearing on course success. Consider it most valuable as an *additional* aid to lectures and individual reading.

"Disadvantages include T.O. limitations (which do not affect the program's validity) or imperfect questions (which should be weeded out when the course is made up). However, even poor questions are valuable if *recognized* as such.

"Neutral is the fact that, however the course is taught, the student must be interested, diligent, and willing to work harder than the course may require (if necessary) to ensure understanding."

"Using punchboards helped make this method of studying more interesting, however, it seems to be more a system of pointing out areas in which the student is weak. In this respect it is helpful, insofar as the student then knows what areas he needs to study."

"The punchboard type of instruction is real good for a refresher type of course but for instruction in a new type of subject the conventional type would be better."

"The biggest advantage is not having to review already mastered material and an instantaneous test critique."

"Self-study need not be with a punchboard. Also, this type of program the study is what is on the test. More information can be presented in other ways. Using the punchboard the questions will eventually end up as big as the original manual."

"In general, I enjoyed participating in the self-study course. I feel that the time spent with it was much more beneficial in learning than the same time would have been in class presentations. However, some class discussion would be helpful along with the self-study. I think, though, that more than one self-study book of questions should be used for each course. I found myself chaining responses from previous questions, and learning to recognize the specific form of the correct response for the question. A re-ordering of questions in an alternate booklet would help, as well as re-ordering of responses. Then the student would be more likely to actually learn the material than a particular response to a particular question. (It's somewhat analogous to learning the particular slides for aircraft recognition that the squadron has in its inventory, and being able to score 100% on a quiz with these slides, yet doing significantly less well with different slides of the same aircraft.)"

"Strength — Good system to teach different people — at different rates — practically painless.

"Weakness — This system needs to be spread out over a larger period. The 2nd time over sight recognition of correct response. Makes the 2nd trip — useless — should be two or three weeks between trials.

"All in all good study device."

"I liked it."

"Haven't formed opinion as yet. The length of the time the material is retained will determine most of my opinion."

"Disadvantage — This is a strictly voluntary or "honor" type study system. In normal use, such as current *mandatory* attendance at ground school, a problem may occur when a person should be studying but will have "something else to do."

"Advantages — It gets the student to review the T.O. — personally and actually study the paragraph in question.

"Disadvantage — A lucky guess may give the correct answer without actually knowing the answer. This applies to all forms of study, so is not a particular disadvantage here.

"If used conscientiously, it should be an effective, time saving method of study."

"I think the program is an advantageous one in that it permits the individual to pace *himself*, ie, breeze through known matter, stress weak areas. It also offers somewhat of a psychological challenge not to punch two and not to hedge or cheat. I would like to see this program instituted for all required learning matter."

"This is a good device when mixed with some group lectures that can present outstanding visual-aids — films, etc."

"Excellent — enjoyed it thoroughly although did not have enough time to properly use the self-study program."

"The self-study program seems better than any other that I have participated in. The only disadvantage is in the fact that questions have to be knit-picking and therefore many in number in order to cover the material adequately. This minor disadvantage is greatly outweighed by advantages as long as the person designing the questions is very careful in preparing them."

"Should have better peg boards."